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DOING WITHOUT DISTRIBUTION IN FORMAL LOGIC

IN the following paragraphs I shall maintain that it is feasible to expound formal logic without making any use of the notion of a distributed term; that the exposition is, indeed, simpler and more readily understood without the doctrine of distribution than with it. Lest this should be regarded as a recantation, let me remind anyone who may have read my article on "The Distribution of the Predicate,"¹ that I expressly reserved judgment concerning the pedagogical utility of the doctrine of distribution, while defending its validity against the destructive criticism of Professor Toohey in his *Elementary Handbook of Logic*. If one succeeds in mastering them, the rules of distribution very conveniently sum up certain of the conditions of validity in conversion and the categorical syllogism. Beginners in the study of logic, however, find the notion of a distributed term exceedingly difficult, and usually apply the rules in a very mechanical fashion. If, then, some alternative tests of validity can be devised which will be easier for the learner to understand, and more nearly in accord with the way in which he naturally tries to "reason out things," the rules of distribution may wisely be laid on the shelf.

By a slight change in the customary order of exposition I have found it possible to get along very well without distribution. This change consists in discussing the hypothetical syllogism before taking up immediate inference and the categorical syllogism, both of which may then be explained in the light of the principles of hypothetical reasoning. That in a general way the categorical and the hypothetical forms of reasoning are equivalent is not, to be sure, a new idea. The traditional view has been, however, that the categorical argument is somehow the normal and natural form; that the categorical syllogism should therefore be explained first; and that the hypothetical should then be shown to be equivalent to the categorical. My suggestion is that in presenting formal logic to beginners this traditional order of exposition should be reversed.

1. *Testing the Validity of Conversion.*—Of the various forms of "immediate inference," the only one which we need to consider is conversion; for it is the only one to which the rule of distribution is applicable. In my former article I advanced the view that a term is not distributed or undistributed absolutely, but only with respect to some other term. Now, in inversion the subject of the original proposition is replaced by its contradictory. In the case of the partial inverse, accordingly, where the rule of distribution seems to

¹ This JOURNAL, Vol. XVII, pp. 519-522.

be violated, the rule is really irrelevant. "All S is P ," being the original proposition, and "Some non- S is not P ," the partial inverse, it is true that P is distributed in the inverse and undistributed in the invertend; but in the invertend it is undistributed with respect to S , while in the inverse it is distributed with respect to non- S ; and from lack of distribution with respect to S we have no right to infer lack of distribution with respect to non- S . Indeed, as Mr. Hammond points out,² if non- S exists (that is to say, if the inversion of "All S is P " is possible), P is distributed with respect to non- S in the original proposition as well as in the partial inverse. If, then, we remember that distribution is a relative notion, that a given term may be distributed with respect to one term and undistributed with respect to another, it is manifest that the rule of distribution is relevant to no form of immediate inference except conversion; since in all the other forms,—obversion, contraposition, inversion,—we change one or both of the terms of the original proposition. In the case of conversion, however, the rule is pertinent. *Neither term of the converse may be distributed with respect to the other, unless in the convertend it was distributed with respect to the same term.* Professor Toohey, it must be conceded, is quite right in maintaining that the attempt to prove the validity of any given process of conversion by simply appealing to this rule would involve us in a circle. The rule of distribution as applied to conversion is not an independent proposition, but rather a corollary from the demonstration of the validity of the processes in question. Nevertheless, admitting this to be its status, it serves as a convenient summary of what is possible and what is impossible in the simple conversion of the four types of the categorical proposition, A , E , I , and O .

If, then, we are to expound conversion without using the notion of distribution, we ought to find another way of summing up these results which is at least equally convenient. This, as I have said, is afforded by the possibility of reducing our propositions to the hypothetical form.

The question is, which of our four typical propositions can be converted simply. Consider first the E proposition, "No S is P ." Its simple converse is, "No P is S ." We wish to prove that we can pass from the truth of either of these to the truth of the other. Now the hypothetical equivalent of the former is, "If x is S , x is not P ," while that of the latter is, "If x is P , x is not S ." And it is evident by the principle of the *modus tollens* that the truth of either of these hypothetical propositions may be inferred from that of the other. Consequently the first of the categorical propositions implies the

² This JOURNAL, Vol. XIX, p. 127.

second, and *vice versa*. If, however, we attempt to convert the *A* proposition simply, we should pass from, "All *S* is *P*," to "All *P* is *S*." Now these propositions are equivalent respectively to the hypotheticals, "If *x* is *S*, *x* is *P*," and, "If *x* is *P*, *x* is *S*." But these are not equivalent to each other; for the attempt to pass from the truth of one to the truth of the other involves the fallacious principle of the "affirmation of the consequent." Consequently the first of these categorical propositions does not imply the second, nor the second the first. Therefore, simple conversion is *not* valid in the case of the *A* proposition.

Granted the results just established for *E* and *A*, granted also the principle of the "square of opposition," it is easy to show whether or not *I* and *O* may be converted. Let *E'* be the simple converse of *E*, *I'* of *I*, etc. Then, if *I* be true, *E* is false, *E'* is false, and *I'* is true; while, if *I* be false, *E* is true, *E'* is true, and *I'* is false. In other words, from the truth of *I* we can infer the truth of *I'*, and from the falsity of *I* the falsity of *I'*. Therefore, the *I* proposition is convertible. In like manner, if *O* be true, *A* is false, *A'* may or may not be false, and *O'* may or may not be true; while, if *O* be false, *A* is true, *A'* may or may not be true, and *O'* may or may not be false. In other words, we have no right to reason confidently from the truth or the falsity of *O* to the truth or the falsity of *O'*. Therefore the *O* proposition is *not* simply convertible.

These results may be stated briefly in the formula that the simple conversion of *E* is analogous to the denial of the consequent, and that of *A* to the affirmation of the consequent in the hypothetical syllogism; while, as regards simple conversion, the case of each of the particular propositions is the same as that of its contradictory.

2. *Testing the Validity of the Categorical Syllogism.*—If distribution is a relative notion, the rules of distribution in the case of the categorical syllogism become, "Neither term of the conclusion may be distributed with respect to the other, unless in its premise it was distributed with respect to the middle term"; and, "The middle term must be distributed with respect to at least one of the other terms." These rules, as necessary (but not sufficient) conditions of validity, proceed from the relations of inclusion and exclusion upon which the categorical syllogism is founded. For the sake of brevity I employ the letters, *S*, *M*, and *P* to indicate, not only the three terms of the syllogism, but also the classes denoted respectively by those terms.

The first rule is evident, then, from the following considerations: (a) To prove that *S* is wholly within (or without) *P*, we must know that *M* is wholly within (or without) *P* and that *S* is wholly within

M. (b) To prove that *P* is wholly without *S* (or a part of *S*), we must know that *P* is wholly without *M* and that *M* includes (at least a part of) *S*.

The necessity of the condition prescribed by the second rule is, if possible, even more obvious. The rule requires, in effect, that if *M* is not distributed with respect to *P*, it must be distributed with respect to *S*. Now suppose that *M* is not distributed with respect to *P*. Then so far as our information goes, *M* may be partly within and partly without *P*. In this case, however, it is evident that the knowledge that *S* is wholly within *M* would not justify any conclusion as to the relation of *S* to *P*, since *S* might not be contained (even partly) in the part of *M* which is within *P*. On the other hand, the knowledge that *S* is wholly *without* *M* would justify a conclusion, other conditions being fulfilled,—for that which is without *M* must also be without the part of *P* which is included within *M*. But in this case, in the only case in which a conclusion is possible when *M* is undistributed with respect to *P*, *M* is distributed with respect to *S*.

It is clear, then, that the notion of distribution, which is irrelevant in the case of the partial inverse, is applicable not only to the converse but also to the categorical syllogism. It is, accordingly, with a certain degree of bewilderment that I read Mr. Hammond's comment that I am "quite right in pointing out that the distribution of a term is not an absolute matter," but that Professor Toohey is also "quite right in maintaining that to make a term distributed or undistributed relatively to some other term and to deny any pertinency to this distribution elsewhere is equally to take all value from distribution." To say that a rule or concept is irrelevant in one specific situation is obviously not the same as to say that it is irrelevant all along the line.

If, then, we are to expound formal logic without making any use of the notion of a distributed term, we ought to find a substitute for such of the traditional rules of the syllogism as involve this notion. This we find in the reduction of all categorical syllogisms to the hypothetical form, when they may be tested by the rules of the hypothetical syllogism. Syllogisms of the third or of the fourth figure are, of course, readily reducible by the conversion (or partial contraposition) of the minor premise to the first or the second figure. It remains to show with what ease we may then complete the reduction to the hypothetical form. Consider these moods of the first figure:

All <i>M</i> is <i>P</i>	All <i>M</i> is <i>P</i>	All <i>M</i> is <i>P</i>	All <i>M</i> is <i>P</i>
All <i>S</i> is <i>M</i>	No <i>S</i> is <i>M</i>	Some <i>S</i> is <i>M</i>	Some <i>S</i> is not <i>M</i>
All <i>S</i> is <i>P</i>	No <i>S</i> is <i>P</i>	Some <i>S</i> is <i>P</i>	Some <i>S</i> is not <i>P</i>

Let us now throw the common major premise into the hypothetical form. "All M is P ," is equivalent to, "if x is M , then x is not P ." Let x equal "any S ." We now have:

If any S is M , then it is P

All S is M	No S is M	Some S is M	Some S is not M
All S is P	No S is P	Some S is P	Some S is not P

It is clear that only the first and third are valid. Next consider several moods of the first figure which have a major premise of type E :

No M is P	No M is P	No M is P	No M is P
All S is M	No S is M	Some S is M	Some S is not M
No S is P	No S is P	Some S is not P	Some S is not P

"No M is P ," is equivalent to, "if x is M , it is not P ." Again let x equal "any S ." We now have:

If any S is M , then it is not P

All S is M	No S is M	Some S is M	Some S is not M
No S is P	No S is P	Some S is not P	Some S is not P

Here, again, it is clear that only the first and the third are valid.

The valid moods of the first figure are then equivalent in each case to a hypothetical syllogism in which the minor premise affirms the antecedent. In other words, the first figure of the categorical syllogism, if valid, reduces to the *modus ponens*. We shall now show that if the second figure is valid it reduces to the *modus tollens*. We shall prove this for but one mood, leaving it to the reader to prove it for the rest.

No P is M = If any S is P , it is not M

All S is M	All S is M
No S is P	No S is P

We notice that the minor premise disagrees with the consequent of the major. The syllogism is therefore valid,—a *modus tollens*.

No mood has been examined in which the major premise is particular. Suppose the major premise to be, "Some M is P ." Thrown into hypothetical form this would give us nothing stronger than, "If x is M , then x may be P ," or, "If x is M , there is a certain degree of probability that it is also P ." But from a major premise no stronger than this, no trustworthy inference can be drawn. Accordingly, if the major premise is particular and the minor universal, the premises should be transposed; while if there is no universal premise, the syllogism is invalid. On the other hand, if there are two universal premises, and with one of them as

major the syllogism appears to be invalid, the premises should be transposed; for in a few cases the syllogism will be found valid when one of the universal propositions is chosen as major premise, although apparently invalid if the other is taken.

It may now be helpful to recapitulate the steps which have been proposed. In each case as many are to be employed as may be necessary.

1. If the major premise is particular, transpose the premises. (The transposition of the premises obviously requires the conversion or the contraposition of the conclusion.)

2. If the syllogism is of the third or the fourth figure, reduce it to the first or the second, as may be the more convenient. In some cases this can be accomplished most readily by converting (or contraposing) the minor premise; in others by transposing the premises.

3. Reduce the syllogism thus obtained to the hypothetical form.

4. Test it by applying the rule of the hypothetical syllogism.

5. If the syllogism has two universal premises, and the test indicates invalidity, transpose the premises, and repeat the test.

Not only is it possible in this way to avoid the use of the difficult notion of a distributed term, but by applying the principles of hypothetical reasoning the other rules of the categorical syllogism may be established:

1. In every valid categorical syllogism there are three terms, and only three; for otherwise there would be no term common to both premises, and in the equivalent hypothetical syllogism, the minor premise, instead of affirming the antecedent or denying the consequent of the major, would be entirely irrelevant, *i.e.*, would say nothing about the major premise at all.

2. If both premises are affirmative, the conclusion must be affirmative; for it is evident that the corresponding hypothetical syllogism, if valid, will be a *modus ponens*.

3. If both premises are negative, the syllogism is invalid. For the major premise will then be equivalent to, "If x is A , then x is not B "; and, as the minor premise is also negative, it can neither agree with the antecedent nor disagree with the consequent of the major.

4. If either premise is negative, the conclusion must be negative. Suppose it is the major premise which is negative. Then, if the equivalent hypothetical syllogism is valid, the minor premise must either agree with the antecedent of the major, in which case the conclusion must agree with the consequent; or the minor premise must disagree with the consequent, in which case the conclusion

must disagree with the antecedent. But in either case the conclusion must be negative. On the other hand, if it is the minor premise which is negative, the syllogism must be a *modus tollens*, and the conclusion will be negative.

5. If both premises are particular, the syllogism is invalid. We have already seen that in the first and second figures the major premise must be universal; and there is no way by which a syllogism with two particular premises can be reduced to an equivalent syllogism having a universal premise.

6. If either premise is particular, the conclusion must be particular. For, when the syllogism is reduced to the first or the second figure, the particular premise will be the minor premise, and its subject will be the minor term and consequently also the subject of the conclusion.

With a little practice the student will learn to tell by inspection, without completing the reduction to the hypothetical form, whether a given syllogism is valid or invalid. In general, if there is a universal premise of which the middle term is the subject, and the other premise is *affirmative*, the syllogism is, or may readily be reduced to, a valid syllogism of the first figure. If, however, after the syllogism has been reduced to the first figure, the minor premise is *negative*, the syllogism is *invalid*. For it is clear that an affirmative minor premise in the first figure will affirm the antecedent, while a negative minor premise will deny the antecedent when the major premise is expressed in hypothetical form.

Likewise, if there is a universal premise of which the middle term is the predicate, and the premises *differ in quality*, the syllogism is, or may readily be reduced to, a valid syllogism of the second figure. If, however, after the syllogism has been reduced to the second figure, the premises do not differ in quality, the syllogism is *invalid*. For if the premises differ in quality it is clear that when the major premise is expressed in hypothetical form the minor premise will deny the consequent; while if the premises are of the same quality, it will affirm the consequent.

My position is, then, that the doctrine of distribution is valid, but that for pedagogical reasons it may well be dispensed with. By adopting the order of exposition outlined in the preceding paragraphs, the "deductive" part of logic is given a unity and interconnectedness such as is not otherwise attainable. An incidental advantage—which has already been hinted at—is that the forms of thinking employed in the exposition are more nearly akin to those of other sciences and of everyday life. The rules of distribution are not likely to be used outside the class-room devoted to the study

of formal logic. On the other hand, the hypothetical forms of reasoning are employed every day, everywhere. They are "identical elements" in many diverse intellectual operations.

This method of exposition is, of course, not wholly new. Mr. L. J. Russell, for example, approximates it very closely in his *Logic from the Standpoint of Education*. But even he—whether because of deference to tradition or for some other reason—presents the hypothetical syllogism *after* the categorical. And most of the text-books proceed on the assumption that the categorical type of argument is somehow the genuine, true and fundamental type, of which the hypothetical is but a more or less unwieldy derivative; as witness the desperate efforts of Jevons and others to reduce all hypothetical propositions to the categorical form. Is it not simpler to reverse the traditional order, to treat the hypothetical as the generic type, of which the categorical is a specific modification? There may be some recondite objection to this procedure; but until it is pointed out, the simpler organization of the subject-matter appears to be preferable.

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BOOK REVIEWS

Human Nature and Conduct: An Introduction to Social Psychology.

John Dewey. Henry Holt & Co. 1922. Pp. 336.

If pragmatism is not the sanctification of commercialism, and of course no one soberly supposes that it is, it may none the less be the intellectual accompaniment of the machine process—of industrial rather than commercial civilization. There is nothing incompatible, so at least Veblen asserts, between a high commercialism and the densest animism—indeed, quite the contrary. A well-matured machine technique, however, presupposes and directly cultivates the scientific temper. The reconstruction of philosophy in modern times must be regarded as a refunding operation through which philosophy is being merged with modern science. This process began with the starry heavens above; Professor Dewey's latest book suggests the speculation that its consummation may be the moral law within.

Naturally the development of empiricism from Bacon and Hobbes to the present revolt against Hegelian absolutism has not been without incident: that wave of absolutism in the nineteenth century is its chief incident. The unsurpassed scientific objectivity of Hume and Kant was swamped in the decades that brought the Holy Alliance and the Wesleyan revival by a general resumption of the